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GB 2197107 A US 5495241 A US 5418358 A
US 4845347 A

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(54) Abstract Title
Portable data carrier operating method

(57) It is determined if the amount of coupled power is sufficient to complete the transaction if a transaction is initiated by a portable data carrier. The portable data carrier is prevented from initiating a transaction if there is insufficient power to complete the operation. A transaction is allowed if there is sufficient power to complete the operation.

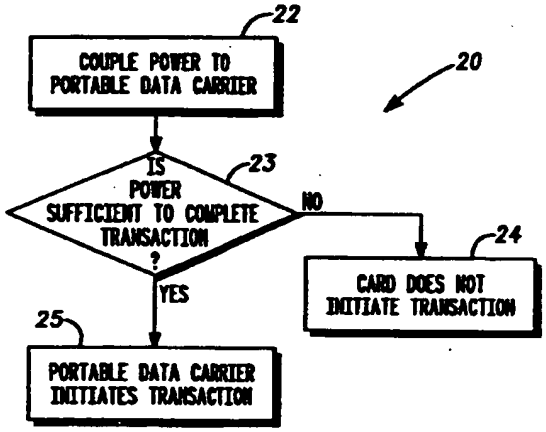

FIG.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

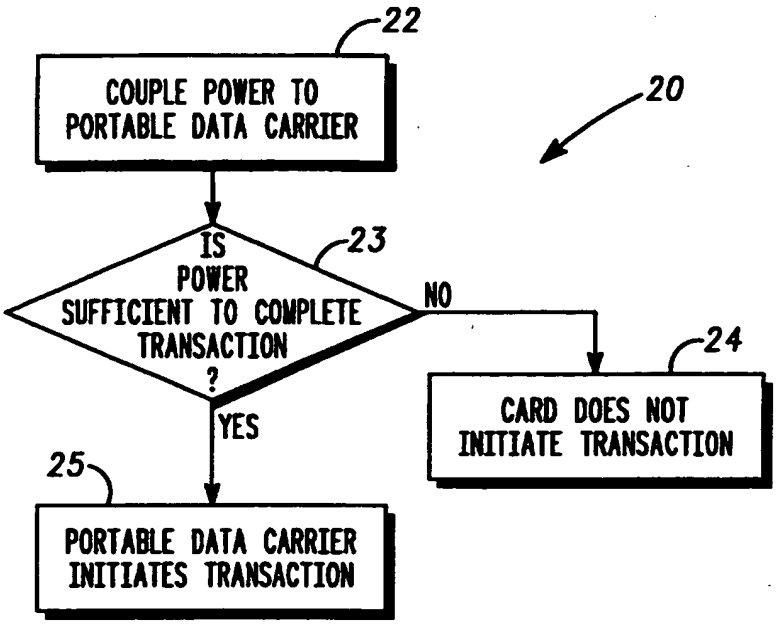
22
COUPLE POWER TO PORTABLE DATA CARRIER
20
IS POWER SUFFICIENT TO COMPLETE TRANSACTION ?
23
NO
24
CARD DOES NOT INITIATE TRANSACTION
YES
25
PORTABLE DATA CARRIER INITIATES TRANSACTION

FIG. 1

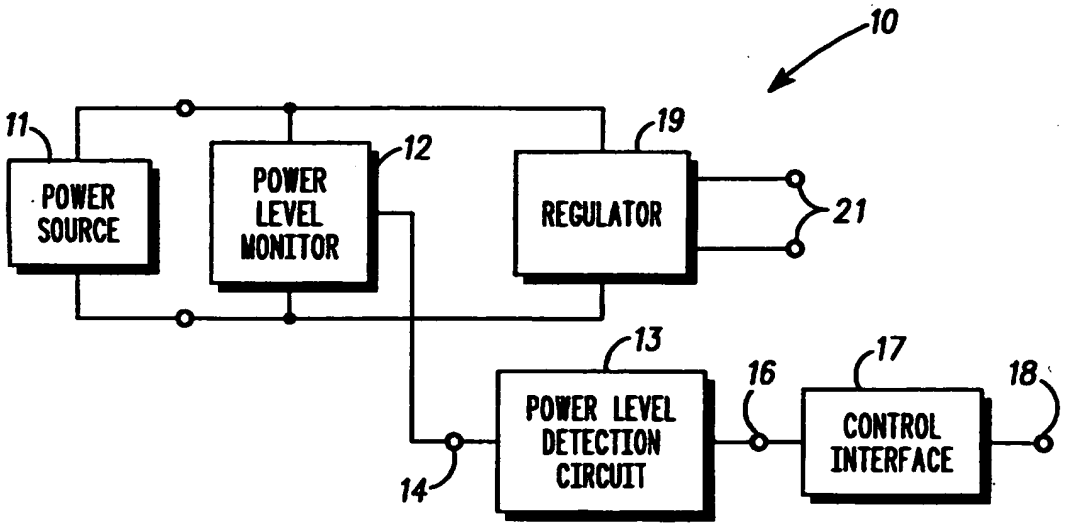
10
11
POWER SOURCE
12
POWER LEVEL MONITOR
19
REGULATOR
21
13
POWER LEVEL DETECTION CIRCUIT
14
16
17
CONTROL INTERFACE
18

FIG. 2

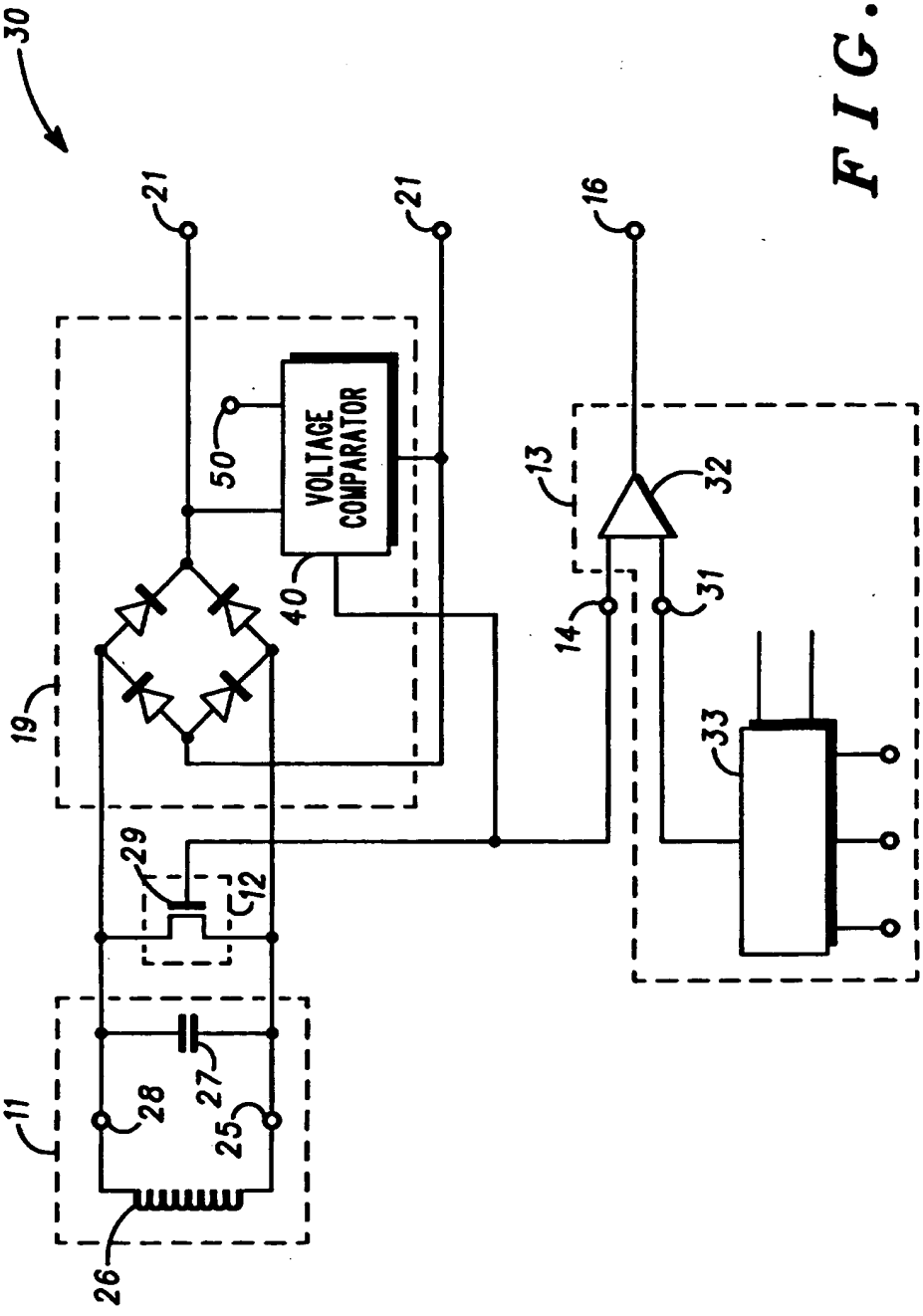
30
21
21
16
50
VOLTAGE COMPARATOR
40
13
32
31
14
19
33
29
12
11
28
27
25
26

FIG. 3

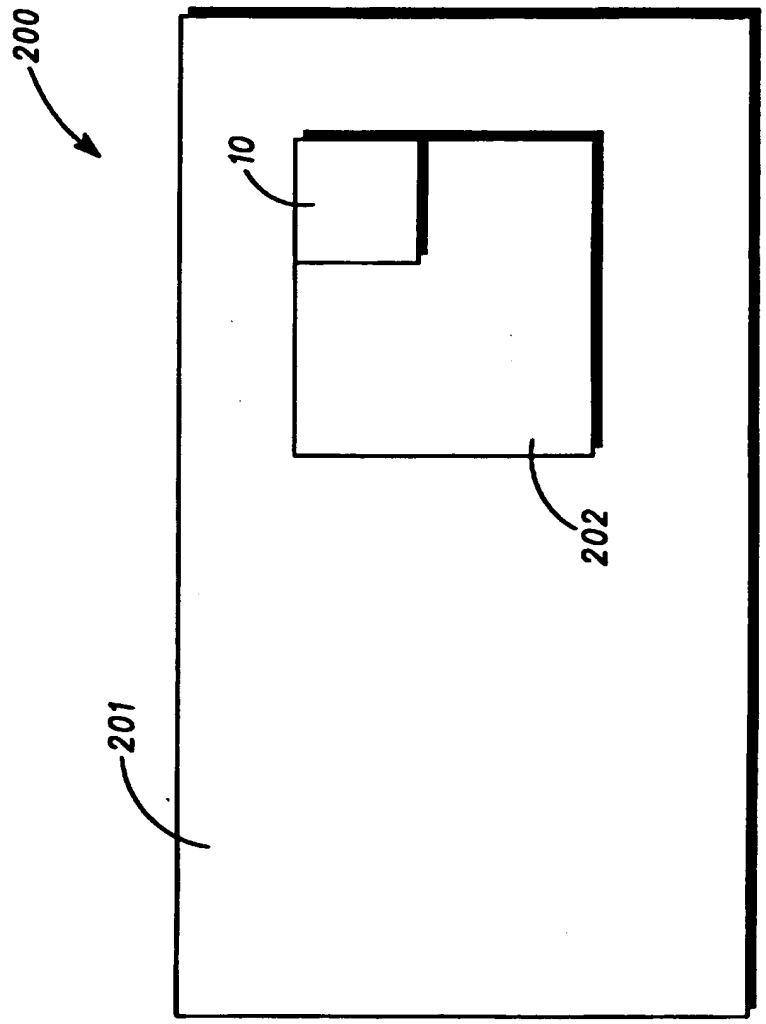

FIG. 4

PORTABLE DATA CARRIER OPERATING METHOD

Background Of The Invention

The present invention relates, in general, to portable electronic devices, and more particularly to a method of operating a portable data carrier.

Portable data carriers have long been recognized within the electronic industry. One example of such a portable data carrier is disclosed in United States patent no. 4,471,216 issued to Robert J.L. Herve on September 11, 1984. As the prior personal data carriers perform operations or electronic transactions, the amount of power available often is insufficient to permit completion of the transaction. Consequently, the prior personal data carrier either terminate a transaction when power becomes insufficient to complete the transactions, or simply continues operation until power is no longer sufficient. This often results in transactions that are not completed or transactions that transfer incorrect data to the portable data carrier or to terminals or other equipment that are receiving information from the portable data carrier.

Accordingly, it is desirable to have a method of ensuring that transactions are completed once they are initiated, and that transactions are completed without errors.

Brief Description of the Drawings

FIG. 1 is a flow chart illustrating an operational method in accordance with the present invention;

FIG. 2 schematically illustrates in block diagram form a circuit that is suitable for supporting operations of a portable data carrier in accordance with the present invention;

FIG. 3 schematically illustrates a circuit suitable for implementing the block diagram of FIG. 2 in accordance with the present invention; and

FIG. 4 schematically illustrates a portable data carrier that utilizes the block diagram of FIG. 2 in accordance with present invention.

Detailed Description of the Drawings

FIG. 1 is a flow chart illustrating a sequence of steps in a method of operating a portable data carrier. In a coupling step 22, power is coupled to a smart card or portable data carrier in order to allow the portable data carrier to operate. In a detecting and comparing step 23, the level of power that is coupled to the portable data carrier is determined and then compared to a transaction power level that represents the amount of power required to perform a transaction once a transaction has been initiated. If the amount of power coupled to the portable data carrier is sufficient, the portable data carrier initiates a transaction as shown in step 25. If the amount of power coupled to the portable data carrier is not sufficient to complete a transaction, the portable data carrier will not initiate a transaction thereby ensuring that no transaction is performed and preventing any erroneous information from being transmitted. Additionally, preventing the initiation of a transaction allows other portable data carriers to initiate transactions thereby making the system more efficient.

FIG. 2 schematically illustrates a block diagram of a power circuit 10 that is suitable for facilitating the steps illustrated in FIG. 1. Coupling power to the portable data carrier is accomplished by a power source 11. The method of coupling power to the portable data carrier could be via connecting the carrier to an external battery, from receiving

power transmitted at various frequencies, or other methods. A power level monitor circuit 12 is utilized for detecting the level of power that is coupled to the portable data carrier and to form an output or coupled power indicator 14. By monitoring the level of power coupled to portable data carrier, control circuitry within the portable data carrier can determine in advance if there is sufficient power available to complete a transaction before a transaction is initiated. A power source regulator 19 is connected in parallel with source 11 and monitor 12, and regulates power that is available to operate control circuitry (not shown) within the portable data carrier. Consequently, regulator 19 has two power output terminals 21 that present operating power to the portable data carrier.

A power level detection circuit 13 is utilized for comparing the level of power that is coupled to the portable data carrier to a transaction power level that is required for the portable data carrier to perform a transaction. Circuit 13 has a power level indicator output 16 that has a first value which indicates that sufficient power is available to complete a transaction, and a second value that indicates there is not sufficient power to complete a transaction if a transaction were initiated. Power level indicator output 16 is presented to a control interface 17 which presents, on an output 18, the value of the power level indicator. The value of the power level indicator on output 18 is used to control circuitry that facilitates performing operations and transactions within the portable data carrier.

FIG. 3 schematically illustrates another power circuit 30 that is a preferred embodiment of power circuit 10 shown in FIG. 2. The same reference numbers are utilized to indicate the same elements within FIG.s 2 and 3. The preferred embodiment of power source 11 is a tuned LC circuit that includes a receiving coil 26 that is tuned to receive power that is transmitted at a frequency, for example 13.56MHz. Source 11 also includes a shunt capacitor 27 to complete the

tuned LC circuit. The power transmission couples power to the portable data carrier. Power level monitor 12 is implemented by a series connected shunt transistor 29 having a drain connected to a return terminal 25 of power source 11, and a source connected to a source terminal 28 of power source 11. The source of transistor 29 is connected to a power supply terminal of circuit 30.

Typically, power source 11 couples more power to the portable data carrier than is required to operate the portable data carrier. Some of this excess power is dissipated by power level monitor 12 in order to prevent the excess power from damaging regulator 19 or other portions of the portable data carrier. In order to accommodate the excess power, power source regulator 19 includes a voltage comparator 40 that is connected across terminals 21. Comparator 40 compares the regulated voltage at terminals 21 to a reference voltage (not shown) that is applied to a terminal 50. When the regulated voltage is greater than the reference voltage on terminal 50, of example three volts, a coupled power indicator or output 14 goes high thereby turning-on transistor 29. This allows transistor 29 to shunt some of the current associated with the excess power coupled to the LC circuit. As the value of output 14 increases, more power is dissipated by transistor 29. The magnitude of the voltage on output 14 is proportional to the excess power thereby indicating the amount of power available for use by the portable data carrier.

To determine if there is sufficient power available, power level detection circuit 13 compares the coupled power indicator to a transaction power level or reference level on a transaction power level terminal 31. As shown in FIG. 3, a voltage comparator 32 compares the voltage presented on output 14 to that presented on terminal 31 and forms a power level indicator on a power level indicator output 16. Circuit 13 also may have an optional selection circuit 33, for example a voltage multiplexer, that is utilized to select a variety of

reference voltages to be applied to comparator 32. More than one reference voltage may be needed because the transaction to be performed by the portable data carrier can be one of several different transactions such as an ordinary debit for fare transactions or other similar operations. Alternately, the transaction can be a longer more complicated transaction such as bank account withdrawals or secure transactions that utilize public key encryption.

FIG. 4 is a block diagram illustrating a portable data carrier 200 that utilizes a power circuit such as circuit 10 or circuit 30. Carrier 200 includes an encapsulation material such as a plastic material that forms a rigid card 201. Carrier 200 also includes control circuitry 202 that may be random logic, hardwired logic circuitry, or a micro-processor or micro-computer unit that includes a processing unit, random access memory, or electrically alterable memory.

By now it should be appreciated that there has been provided a novel method of controlling the operation of a portable data carrier. Monitoring the amount of power that is coupled to the portable data carrier allows determining if there is sufficient power for the portable data carrier to complete a transaction once a transaction is initiated. By preventing the initiation of a transaction if there is not sufficient power to complete the transaction, ensures that the operations or transactions performed by the portable data carrier will be completed and that the portable data carrier has sufficient power to verify that transactions were completed properly. This method of operation improves the reliability of the transactions performed by the portable data carrier and reduces errors over operations that are performed by the prior art.

CLAIMS

1. A method of operating a portable data carrier comprising:

coupling power to the portable data carrier;

detecting a level of power that is coupled to the portable data carrier to form a coupled power indicator;

comparing the level of power to a transaction power level to form a power level indicator; and

presenting the power level indicator to a control circuit.

2. The method of claim 1 further including preventing initiation of a transaction operation by the portable data carrier when the power level indicator is a first value and allowing a initiation of a transaction operation when the power level indicator is a second value.

3. The method of claim 1 or 2 wherein detecting the level of power includes monitoring current shunted across a receiving coil of the portable data carrier.

4. The method of all preceding claims wherein comparing the level of power to the transaction power to form the received power indicator includes comparing the coupled power indicator to a reference value.

5. The method of all preceding claims wherein presenting the power level indicator to the control circuit includes presenting the power level indicator to a microprocessor unit.

6. The method of claim 2 or 3 or 4 wherein preventing initiation of the transaction operation by the portable data carrier when the power level indicator is a first value and allowing a initiation of a transaction operation when the power level indicator is a second value includes reading the power

level indicator by a microprocessor unit wherein the microprocessor unit does not execute transaction operations when the power level indicator is the second value.

The Patent Office

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Application No: GB 9701957.4 **Examiner:** John Donaldson
Claims searched: 1 to 6 **Date of search:** 19 February 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G4M(MBF, MCF, MD, MF)

Int Cl (Ed.6): G06K 7/00, 7/01, 7/04, 7/06, 7/08, 17/00, 19/00, 19/06, 19/067, 19/07, 19/073

Other: Online:WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2197107 A	(MARS), see page 4, lines 8 to 20	1 to 5
X	US 5495241	(DONIG), see column 7, lines 25 to 57	1 to 4
X	US 5418358	(BRUHNKE), see column 4, line 10 to column 5, line 25	1 to 4
X	US 4845347	(MCCRINDLE), see column 3, lines 21 to 37, column 5, line 44 to column 6, line 4	1 to 4

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.